PART I - ADMINISTRATIVE

Section 1. General administrative information

Title of project

Remove Excess Heat From Streams And Store It For Future Application

BPA project number: 20050
Contract renewal date (mm/yyyy): ☐ **Multiple actions?**

Business name of agency, institution or organization requesting funding
Parker's Inc (a close held general corp) dba BETTERFISH

Business acronym (if appropriate)

Proposal contact person or principal investigator:

Name	Robert L. Parker
Mailing Address	825 NW Fenton St.
City, ST Zip	McMinnville, OR 97128
Phone	(503)434-6600
Fax	
Email address	rparker@onlinemac.com

NPPC Program Measure Number(s) which this project addresses

FWS/NMFS Biological Opinion Number(s) which this project addresses

Other planning document references

Short description
Build and field test a portable heat pump that could remove excess heat from streams. Determine through field tests if it is economically feasible to store and utilize that recycled heat for aquaculture and other purposes.

Target species
salmon, steehead, trout

Section 2. Sorting and evaluation

Subbasin
Yamhill for research. Applicable system wide if results are positive.

Evaluation Process Sort

CBFWA caucus	Special evaluation process	ISRP project type
Mark one or more	If your project fits either of these	Mark one or more categories

caucus	processes, mark one or both	
☒ Anadromous fish ☒ Resident fish ☐ Wildlife	☐ Multi-year (milestone-based evaluation) ☐ Watershed project evaluation	☐ Watershed councils/model watersheds ☒ Information dissemination ☐ Operation & maintenance ☐ New construction ☒ Research & monitoring ☐ Implementation & management ☐ Wildlife habitat acquisitions

Section 3. Relationships to other Bonneville projects

Umbrella / sub-proposal relationships. List umbrella project first.

Project #	Project title/description

Other dependent or critically-related projects

Project #	Project title/description	Nature of relationship

Section 4. Objectives, tasks and schedules

Past accomplishments

Year	Accomplishment	Met biological objectives?

Objectives and tasks

Obj 1,2,3	Objective	Task a,b,c	Task
1	Build the testing unit	a	purchase water chiller, generator & trailer
		b	mount chiller and generator on trailer
2	Assemble auxiliary equipment	a	purchase 2 pumps, 2 knockdown water tanks, pipe, etc, & pond liner.
		b	assemble the equipment so that it can be carried on the trailer and readily set up and broken down for use at various locations.
3	Test the efficiency of the unit under field conditions	a	dig a pond on BPA or City property in McMinnville adjacent to Yamhill River.
		b	line the pond and fill it with the cleanest

			water available
		c	with the help of Linfield College students determine the volume of water, temperature of the water, and the temperature of the river
		d	set up the tanks alongside the pond and fill them
		e	Run the unit for a measured time and determine the kilowatts used
		f	With the help of the students measure the results and weigh it against the cost of the electricity. How mand BTUs were removed from the river? What monetary value might be attached to that?
4	Test the heat storage capapcity of the pond	a	track the termperature over a period of time
		b	Determine the rate and amount of heat loss.
		c	Calculate the cost to replace the loss with the methods we are using and the size of equipment needed.
		d	Compare the loss in tanks with the loss in ground
5	Test the practicality of storing heat in the ground	a	Bury a length of plastic tubing made for the purpose.
		b	Tansfer heat “downhole” into a sectionl of ground.
		c	Bury a similar length some distance away.
		d	After some time, try to retieve the buried heat.
		e	Compare the results from the heated ground with the ground that was not heated.
6	If results are positive then use the unit to promote commercial aquaculture (or any other use of the heat) wherever salmonid bearing waters get too warm.	a	Assemble the equipment at any logical location.
		b	transfer heat to an available or created pond or tank.
		c	try to sell a “package” custom designed to serve the customer’s heat needs, taking the heat from the nearest stream and creating storage as needed.
7	Make the unit available to any agency that has need for demo or promotion or training or research on a mileage and per diem basis.	a	assemble the equipment where requested.
		b	conduct demos, seminars, etc
		c	assist agency research
		d	make commercial sales when proper.
8	publish results	a	organize applicable data
		b	distribute results to interested parties

Objective schedules and costs

Obj #	Start date mm/yyyy	End date mm/yyyy	Measureable biological objective(s)	Milestone	FY2000 Cost %
1	11/1999	1/2000			67.20%
2	11/1999	1/2000			22.25%
3	1/2000	4/2000			1.55%
4	1/2000	9/2000			0.00%
5	1/2000	9/2000			0.00%
6	1/2000	9/2010			0.00%
7	1/2000	9/2010			0.00%
8	5/2000	8/2000			9.00%
				Total	100.00%

Schedule constraints
No schedule constraints foreseen

Completion date
All funds except $600 for printing will be expended by February, 2000. The testing and use of the equipment will be ongoing but will not require further funding from BPA.

Section 5. Budget

FY99 project budget (BPA obligated):

FY2000 budget by line item

Item	Note	% of total	FY2000
Personnel			
Fringe benefits			
Supplies, materials, non-expendable property	accessories & thermometer	%22	6,660
Operations & maintenance			
Capital acquisitions or improvements (e.g. land, buildings, major equip.)	heat pump,generator, trailer	%67	19,600
NEPA costs			
Construction-related support			
PIT tags	# of tags:		
Travel			
Indirect costs			
Subcontractor	local cat & backhoe driver or BPA provided in lieu of expenditure	%7	2,300
Other	printing final reports	%2	600
TOTAL BPA FY2000 BUDGET REQUEST			$29,160

Cost sharing

Organization	Item or service provided	% total project cost (incl. BPA)	Amount ($)
		Total project cost (including BPA portion)	$29,160

Outyear costs

	FY2001	FY02	FY03	FY04
Total budget				

Section 6. References

Watershed?	Reference
☐	Robert L. Moffatt, Roy E. Wellman, and Janice M. Gordon - 1990 - Statistical Summaries of Streamflow Data In Oregon: Volume I, Monthly and Annual Streamflow, and Flow Duration Values - File Report 90-118 - U.S. Geological Survey -Portland, Oregon
☐	July 1996 - DEQ’s 1994/1996 303(d) List of Water Quality Limited Waterbodies & Oregon’s Criteria Used For Listing Waterbodies.
☐	
☐	

PART II - NARRATIVE

Section 7. Abstract

Most streams in the Columbia Basin are too warm for healthy salmonids from July through October. One way to cool those streams is to transfer the excess heat to beneficial purposes with HEAT PUMPS. Air to air heat pumps heat space for 1/3 the cost of electric heat. Water to water heat transfer costs only 1/8 as much as creating heat. Fifteen buildings in downtown Portland presently take their heat from the Willamette River. Any municipality bordering a stream should take the excess heat from the water, distribute it, and sell it as a utility. In rural areas large quantities of heat should heat ponds to enable warm water aquaculture in the Northwest.

Cooling a river is a “free” side benefit of heat exchange just as flood control is a “free” side benefit of building dams. The dams would never have been built without the commercial aspect of power sales.

Flood control relies on storing excess seasonal runoff water. Cooling streams has the same seasonal problem, requiring heat storage. The excess heat peaks at the time of least need to utilize the heat elsewhere.

My project is to assemble a portable heat pump to demonstrate, teach, and promote sales and to use the unit to heat up quantities of water and/or soil to quantify the practicality of storing heat for future use, extracting it later with the same unit (simple field study, not original research).

Section 8. Project description

a. Technical and/or scientific background

The problem that my project seeks to address is that most streams in the Columbia River Basin get too warm in July through October. Oregon DEQ states that 64f is the maximum temperature that salmonids should ever be subjected to, and that it is essential to hold it down to 55f during spawning, egg incubation, and fry emergence. The 55f during spawning is usually not a problem because there is sufficient rain and major irrigation is over, but many streams are over 64f in August and September.

High temperatures in the water increase the growth rate of fungus and bacteria harmful to fish. The combination of heat, fertilizers from fields, and sunshine promotes algae growth, not too harmful to fish until it dies at night and uses up what little oxygen the warm water contains.

Government attempts to solve such problems always focus on human behavior modification. In this case the efforts focus on, (1) stopping riparian damage from cattle, etc., (2) maintaining and promoting shade cover, aquatic plants, etc., and (3) decreasing irrigation so as to maintain better streamflow. All of these are proper, good, and helpful.

My solution must be applied privately because it involves profits and prosperity. Heat is a valuable commodity. Tremendous resources are applied and consumed in the effort to create enough heat to satisfy modern man's needs. Recycling the excess solar energy (heat) that accumulates in streams is a very cost effective way to provide any heat that mankind needs (up to about 140f) and is the "greenest" possible heat source.

The people that need the cheap heat need to see a demonstration before they believe that it only costs 1/8th what they are now paying. My project builds a portable unit to provide that demonstration. The demo unit has been designed to be the right size to also carry out a research project, to determine the practicality of storing heat in a pond or in the ground.

It is a reach to call this a "research" project. It is really a field study to quantify what is already known in theory. Anyone with moderate experience and common sense can learn whether or not it is practical to store heat in a pond or in the ground and can write up meaningful conclusions. There are so many site specific variables that laboratory accuracy would not be helpful. If it appears that we can store and recover heat with moderate success then it is time to bring in the specialists to study a specific site.

It is practical to transfer heat from streams year round, without storage. The storage is what will help the fish the most. It takes a huge amount of refrigeration tonnage to cool a stream. Application of that heat readily justifies the expense of installing that tonnage. If the excess summer heat cannot be stored then someone is going to have to pay for running that equipment for the sole purpose of cooling the stream. Will the taxpayer be willing to do that? If the excess heat can be stored until the seasonal need for cooling is past, and then the stored heat is drawn down (by the same machinery) and distributed, the cost to cool streams at low flow is minimal and industry and utilities can stand to do it without subsidy.

b. Rationale and significance to Regional Programs

If heat storage is not practical this project will still promote greatly increased removal of heat from streams. If heat storage is practical it will remove that heat at the time when it is most damaging to salmonids. Either way we will promote removal of heat from every stream, in the Northwest in areas where people live and/or farm.

The problem of excess heat is universally recognized. As far as I can tell no agency is trying to remove the excess heat and transfer it to beneficial (profitable) use. My approach seems to be unique. I am coming at it from the world of competitive economics (Capitalism works. All taxes and EVERYBODY'S salaries come from profits). If I have the means to demonstrate heat exchange there will be greatly increased use of it.

c. Relationships to other projects

There are other projects that seek to avoid excess heat from reaching the streams. They are effective in small streams and have many other tremendous benefits of great value. Cooler water entering the larger streams is very helpful. Further downstream, as the medium sized streams are too wide to shade, and stop cascading, and start to flow sluggishly, there is no natural process that will cool the water and no way to prevent passive solar heat collection.

My method of removing heat with a mechanical process becomes effective here. My method is unobtrusive. It does not interfere with any fish, animal, or plant. It does not intrude upon any use or access that humans enjoy. It does not coordinate with other efforts but does not hinder in any way. The combined results help salmonids.

Paul Heberling (Roseburg (541)440-3338 ex224) is the resident DEQ engineer working on the Umpqua. He is interested in the results of my project. John Gasik (Medford (541)776-6010 ex230) is the DEQ engineer working on the Rogue. He is interested. The third sub basin to be worked on will be my river, the Yamhill. Whoever comes here will surely want to know what results I obtained.

d. Project history (for ongoing projects)

The project itself has no history because it has not begun, but there is a considerable history of events that brought me to attempt this project.

There is an increasing need throughout the world for finfish and shellfish. Fish is recently recognized as the healthiest protein source because it contains Omega 3 oil. At the same time as we have an increasing market the supply of caught fish is rapidly diminishing. Wherever conditions are right fish are being farmed today.

Washington raises prodigious supplies of shellfish (but not nearly enough) and some salmon in Puget Sound. Idaho and Montana supply us with a lot of trout (cold water fish). Washington and Oregon raise insignificant amounts of freshwater fish.

The fish farms that are productive and profitable raise warm water fish, catfish, bass, tilapia, some sturgeon. The primary requirement for raising warm water fish is warm water. Warm water fish feed heavily and grow rapidly in water that is 75f to 80f. Conventional wisdom is that you can’t afford to heat water for this purpose. You can if you are using waste heat or if you TRANSFER heat out of streams.

Fish are being raised as far North as Sacramento where they have a 65f aquifer. Except for geo-thermal areas our ground water is 55f

In Oregon, in order to preserve farm land, you cannot put a new residence on land zoned for farming. Aquaculture is farming and is recognized as an outright use on agricultural land. The Catch-22 is that they did not anticipate there ever being any NEW farms. Fish raising can be extraordinarily profitable on a per acre basis, partly because the crop lives in three dimensions and we deal in acre-feet. A family farm can be very successful on as little as 20 acres but---you must live on a farm, especially a fish farm, because the fish need constant monitoring and---you are not allowed to live on the new farm for two years. I asked fish farmers around Sacramento why they did not come to Oregon and they all said, “OREGON IS VERY UNFRIENDLY”.

And so, instead of starting up family fish farms I must go to existing land owners to see if they want to try a sideline on a piece of their ground that is useless or borderline for other crops. Pretty hard sale to make because they are busy doing what they know.

There are other agricultural uses for heat. Warm water, fish enriched effluent from fish ponds could raise winter strawberries, asparagus, etc. hydroponically under inexpensive greenhouse cover. No farmer that I talked to saw any drawbacks to warming up the ground itself in the fall. A crop like winter wheat would be greatly enhanced. How about heat storage under the runways at the Portland Airport **-** or under freeways?

e. Proposal objectives

1. Build the Unit **- -** The “unit” is a heat pump powered by a generator, both mounted on a trailer so that it can be towed anywhere that has a source of water, and heat transfer can be demonstrated and/or accomplished.

2. Assemble auxiliary equipment **- -** The trailer is built to also carry all of the auxiliary equipment to the site. The “unit” transfers heat. The auxiliary equipment moves and holds water, essential for demonstrating and/or accomplishing heat transfer.

3. Test the efficiancy of the “unit” under field conditions **- -** All of the equipment is standard, commonly used, off the shelf components. Each component has been tested and rated and it’s efficiency is known under ideal conditions. We must test the combined components under field conditions to find out how well the “unit” performs in the field. Our main concern is how many KWH were needed to transfer how many BTUSs.

4. Test the heat storage capacity of the pond **- -** We will erect knockdown tanks and dig a hole and line it. We will put a like quantity of water in the tanks and in the lined pond and heat the water. We then measure the rate and amount of heat loss to determine if either is reasonable and if one is superior to the other for heat retention.

5. Test the practicality of storing heat in the ground **- -** The heat pump we are using utilizes a “loop” of coolant in a plastic pipe buried in the ground. Instead of removing heat from the ground we will use our loop to heat the area. We will then measure heat loss and migration to determine if storing heat in the ground is practical.

6. If results are positive then use the unit to promote commercial aquaculture (or any other use of the heat) wherever salmonid holding waters get too warm **- - -** Selling the heat is the only way that extensive stream cooling will ever take place. Most heat exchange wastes one end of the process. When we remove heat from the atmosphere and transfer it into our house we utilize the heat but there is no benefit from the cooling. When we extract heat from our house with an air conditioner we throw the heat away. Transferring heat from streams is the rare instance of benefiting from both sides of the process. The monetary value of the heat should be enough to make the stream cooling “free”.

7. Make the unit available to any agency that has need for demonstration or promotion or training or research **- - -**Mt. Hood Community College has already expressed an interest in using the unit on occaision. Clark County PUD is heating their building with one of these heat pumps. Every agency, college, city, hatchery, household, farm, etc. should be interested in seeing how this works if I can make my availability well enough known.

f. Methods

The heat pump is called a water chiller because both the evaporator and condenser have water jackets creating plenums for heat exchange right next to the compressor. If the water to be heated and cooled is clean enough then it is pumped directly through the water jackets and returned to the containers. The vernacular for that technic is called “pump and dump”. It is very hard to clean the inside of the water jackets so if the water is as dirty as the Willamette River then a closed LOOP is used so that clean water with 15% methanol added is the only liquid that contacts the jackets. Our 5 ton heat pump requires 900 feet of flexible plastic pipe to obtain enough surface contact to cool or heat with a loop. This is neccessary and practical in a stream but very inconvenient in a tank. The 900 feet of pipe is coiled, the coils separated

3/4” and bound into bundles. The pipe is flexible enough to allow tossing the bundles into the stream and tying them to something.

There is no other way than a loop to exchange heat in the ground. A standard arrangement in the ground is to bury the 900 feet of line 5 feet deep. Several pipes are fed out of a “header”. They are laid out one foot apart and the liquid is picked up by another header (or footer) to form a continous loop. This underground loop is usually used to extract heat from the ground but we will use it to heat the ground. DOWNHOLE heat exchange of this volume is specifically allowed without permit in Oregon.

The rather expensive thermometer gives a readout instantly and has a probe. This is very convenient to measure water temperature without having to wait and wonder if you waited long enough. To measure heat loss and rate of loss in a tank or pond only requires periodic temperature checks at regular intervals.

To measure heat loss and heat migration in the ground, vertical sections of PVC pipe will be placed in the heat field at regular intervals. Specific distances will be determined when the dimensions of the field are known. The pipe sections must be large enough in diameter so that the thermometer probe can easily be dropped to the bottom and touch the ground. The pipes will be loosely capped to keep air circulation from distorting the temperatures. Since the loop is five feet deep I will place three test pipes at each location, one reaching the full five foot depth, another that reaches down three feet and a third one that measures temperature just one foot below the surface. The three pipes will be bound into a bundle, volor coded, and will extend at least one foot above the surface so that they can be easily located and accessed. All temperature measurements, records, and reporting documents will be in Fahrenheit because I prefer it (and my customers are more likely to readily understand it). The test pipe locations will extend past the furthest likely extent of heat migration. Temperatures will be read at each location before applying any heat to be sure that the area is uniform (not impacted by an extraneous heat source) before starting the tests.

A 5 ton unit will not make a noticeable reduction in the temperature of the Yamhill River at it’s lowest flow (12 cubic feet per second). By measuring the heat increase in known quantaties of water and the amount of running time to achieve the heat increase we can estimate the amount of similar equipment needed to alter a given flow a given amount. In theory we already know that the definition of a BTU is the amount of heat needed to raise one pound of water 1 degree Fahrenheit. It is practical to assume that a BTU deposited in a tank equals a BTU removed from the river.

g. Facilities and equipment

My project does not include what most applicants would consider to be MAJOR facilities and equipment but they are major to me. The heat pump will be a 5 ton water chiller manufactured by WATER FURNACE Model SXW060 net weight 275 lbs. That is large enough to quickly heat a large swimming pool but small enough to be practical with the small portable tanks (750 gallons each). The generator will be a 20KW, 230V, water cooled, skid mounted unit, fueled by butane or natural gas. Manufacturer will be either Onan Cummins or Kadolite. The reason for water cooled is that it will allow for future development of co-generation. The reason for butane or natural gas is the clean exhaust, mostly CO_2 and hardly any carbon monoxide. The trailer will be locally built or adapted from existing components. It must allow ready access to all equipment and look pretty decent.

h. Budget

Most of the budget is applied to capital outlay for equipment acquisition. My equipment would not qualify as major expenditures in a large project but they are large in my view. All of the equipment requested has been quoted except the trailer. All of the quotes have been rounded off SLIGHTLY upward to insure that all of the needed equipment could actually be obtained for the requested amounts a year from now.

It must surely be unusual for you to receive a request with no wages or reimbursement for personnel. The reason for that is that I am an individual, not an agency and that my project will not be completely successful unless a lot of commercial application ensues. Unlike an agency employee, I benefit by receiving commissions, fees, etc. from the money spent by people who invest in heat transfer from streams.

I also am available, (along with the equipment), for a nominal fee, for any legitimate purpose proposed by an agency.

The simple nature of the field study makes it possible for me to conduct the experiments by myself. Water Furnace already has considerable statistics as do the industry wide organizations. Local college students and their teachers will surely add to my current thinking and find ways to expand the usefulness of the project.

If the field studies are done on BPA land the cat and backhoe work might be done by BPA employees in leiu of a cash outlay. I may rent a machine and move dirt myself.

Section 9. Key personnel

I am the key personnel. Robert L. Parker - Born 11/16/32 (66 years old) BA Uof O 1958, MA Uof O 1963 - - Education Major. Taught in Oregon public schools for 20 years. Registered contractor for 12 years developing land and building residential. 10 yrs in retail. Owned TV & Appliance stores in McMinnville, Bend, and Albany. Serviced agents in Astoria, Seaside, Long Beach WA, Hillsboro, Salem, Woodburn, and Bend. Sold retail outlets, used profits to buy a small development parcel of land in McMinnville. Went bankrupt, selling the parcel at a loss. "Retired" but active in several small ventures.

Specific qualification for the proposed work is that I know as much or more about warm water aquaculture as anyone in Oregon who has not actually worked on a farm. I am well versed in heat production, co-generation, recycling waste heat, and water to water heat transfer. I have seen state of the art facilities that apply these technics to aquaculture in California.

I am a certified teacher able to conduct a seminar on water to water heat transfer. I am also a showman who can keep the attention of an audience and make a demo fun. I am a salesman who can close a deal with a home owner, a farmer, or the City of Portland.

Section 10. Information/technology transfer

I intend to organize and print the following items and mail, or otherwise make them available, to anyone who is interested: (1) parameters of my study and the raw data gathered, (2) my conclusions drawn from that data, (3) selected data and conclusions from other named sources, and (4) a sales pitch touting the advantages of water to water heat exchange and the reasons to pay me to assist in implementing systems.

Each of those four items will be separate, independent of each other, and clearly labeled. #1 will not contain my opinions, other data and/or opinions, or puffery. #2 will not contain other data and/or opinions, or puffery. #3 will not contain puffery. #4 will be a real zinger with no holds barred.

Congratulations!